Remarks

Claims 21-32 and 34-36 remain in this application. Claim 33 has been canceled because its subject matter has been incorporated into Claim 32. Claims 1-20 have been canceled. In view of the Examiner's earlier restriction requirement, Applicant retains the right to present Claims 1-20 in a divisional application(s).

Responses to the rejections of the pending claims are as follows:

Rejections Under 35 USC § 112

Claims 21-29 were rejected under 35 USC § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicant regards as the invention. In essence, this rejection asserts that Claim 21 implies that extraction of heat from cooling water outside of containment lowers the pressure in the pressure vessel while it is the combination of extracting heat and the pressure escaping through the loss of the coolant pipe break hole that actually lowers the pressure in the reactor pressure vessel. It is further asserted that since the West et al. (US 3,718,539) reference states that, dependant on pipe break size, the pressure in the reactor pressure vessel and containment can be equalized in five minutes or less, that Applicant's "claims are broader than the specification disclosure statement".

This rejection is respectfully traversed. West et al. is irrelevant with regard to Claims 21-29. West et al. discloses a "conventional" pressurized water reactor (PWR) in which the steam generators are outside, and separate from, the reactor pressure vessel, but are connected therewith through large pipes, often over 30 inches in diameter, to form the primary loop. As noted, the worst case loss of coolant accident (LOCA) in such a reactor system postulates rupture of one of these very large pipes, which in fact can result in equalization of the pressure in the reactor pressure vessel and in containment in a very short period of time.

On the other hand, the subject claims are directed to a method of operating a PWR having a containment structure containing a integral reactor in which the steam generators are mounted together with the reactor core in a pool of reactor coolant in the reactor pressure vessel. "The integral type reactor pressure vessel eliminates the large loop piping that is normally used to connect the individual components, and thus eliminates the possibility of a large LOCA." Specification page 6, lines 6-8. In fact, "[d]ue to the absence of any primary loop piping, the PWR 1 will have no piping connections larger than 2.6 inches in diameter". Specification page 11, lines 16-17. As a result, if one of these lines ruptures, the leak is relatively small and while the pressure in containment rises due to the leak, reactor

pressure vessel pressure remains above the pressure in containment for an extended period of time. Although the largest pipe connection to the reactor pressure vessel in the example is 2.6 inches in diameter, the analysis set forth in the specification assumes for conservatism a break equivalent to a pipe 4 inches in diameter. Specification page 11, lines 17-20. For this assumed LOCA; Figure 3 illustrates containment pressure identified by the reference character 65 and the reactor pressure vessel pressure indicated by the reference character 67. As shown there, reactor pressure vessel pressure 67 quickly decreases and containment pressure 65 rapidly rises and peaks at approximately 1600 seconds (a little under one half hour) then decreases together with reactor pressure vessel pressure 67. This equalization of pressure occurs even this early because of the claimed process by which heat is extracted from the reactor pressure vessel by circulating cooling fluid through the secondary circuit of the steam generators to withdraw heat from the reactor pressure vessel and thereby condense steam within the reactor pressure vessel. This condensing of steam in the reactor pressure vessel lowers the pressure in the reactor pressure vessel, and with it the pressure in containment. Through this claimed method of heat removal by way of the steam generators, the loss of mass from the reactor pressure vessel effectively stops and the reactor pressure vessel pressure 67 actually becomes lower than the containment pressure for a significant period of time, as illustrated in Figure 4. As shown there, there is a period of time from about 2 to 12 hours where the break flow is actually negative; *i.e.*, steam (and in-condensible gas) is being drawn into the reactor pressure vessel. See specification page 12, lines 1-13.

Thus, in accordance with Claim 21, heat is extracted from the cooling water outside a containment structure at a rate which condenses sufficient steam in the reactor pressure vessel to lower the pressure in the reactor pressure vessel to a pressure at or below the pressure in the containment structure thereby stopping or reversing the mass flow of the reactor coolant from the reactor pressure vessel. As illustrated by the analysis in the specification, the exemplary system extracts the heat at a rate such that mass flow out of the reactor pressure vessel is stopped or reversed within about two hours or so for a four inch break. The specification at page 13, also postulates a two inch break wherein the containment pressure rises to the reactor pressure vessel pressure in approximately 4000 seconds (a little over an hour) as shown in Figure 6. As shown in Figure 7, mass flow out of the reactor is stopped and actually reversed in a little less than about three hours. Therefore, while the exact time it may take for the pressure in the reactor pressure vessel to be brought below the pressure in the containment structure through heat extraction from the reactor pressure vessel does depend to some extent upon the size of the break, the method of Claim

21 calls for the heat to be extracted at a rate such that this result is reached "within about three hours". Thus, it could occur in a shorter time, which would be "within about three hours".

Accordingly, Claim 21 as now presented does particularly point out and distinctly claim the subject matter which Applicant regards as the invention and therefore meets the requirements of 35 USC § 112, second paragraph. As Claims 22-29 were rejected only through their dependency on Claim 21, they too meet the definiteness requirements of the statute.

Rejection of Claims 21-23 and 28 Under 35 USC § 103

Claims 21-23 and 28 were rejected under 35 USC § 103(a) as being unpatentable over Matzie et al. (Nuclear Engineering and Design 136 (1992)) in view of West et al. (US 3,718,739). Matzie et al. is relied upon as showing an integral design for a PWR including a secondary condensing system outside of the containment structure and is said to disclose the claimed invention except for reciting the time period for equalizing reactor pressure vessel and containment structure post-LOCA pressures. West et al. is cited as disclosing that the time period for equalizing these pressures is dependent upon the size of the LOCA break.

While Matzie et al. discloses an integral PWR, it relies on different processes for responding to a LOCA. While Matzie et al. discloses a secondary condensing system, "[t]he condensing pool is sized to absorb a minimum of 72 hours of **decay heat** by boil off" (emphasis added). Matzie et al. page 79, left column, lines 4-5. This capacity for removing decay heat is totally inadequate to remove heat from the reactor pressure vessel at a rate which, within no more than about three hours, condenses sufficient steam in the reactor pressure vessel to lower pressure in the reactor pressure vessel to a pressure at or below the pressure in the containment structure. The principal mechanism used by Matzie et al. for lowering the pressure in the reactor pressure vessel is through the use of suppression tanks. Steam that has escaped from the reactor pressure vessel into the reactor vessel compartment is condensed in the water in a farm of suppression tanks located outside of the reactor vessel compartment (see Matzie et al. Figure 3). These suppression tanks are finned to promote heat transfer to ambient air circulated around the suppression tanks located outside of containment. Matzie et al., page 80, left column, last paragraph. "The water temperature and thus the containment pressure is passively controlled by rejecting heat from the suppression tanks through natural convection heat transfer on the outside of the tanks." Matzie et al., page 80, right column, third from last sentence, first paragraph.

Thus, Matzie et al. operates differently from the method set forth in Claim 21. The process of Claim 21 removes heat directly from the reactor pressure vessel using the secondary circuit, thereby reducing pressure in the reactor pressure vessel and sucking steam from the containment structure back into the reactor pressure vessel through the break where it condenses to add to the coolant inventory in the reactor pressure vessel. Matzie et al. relies on reducing pressure in containment and removing heat through a large suppression tank pool. Coolant is added to the reactor pressure vessel from the suppression tank pool. However, as the pressure remains high in the reactor pressure vessel (due to the inherently small LOCAs in an integral reactor) Matzie et al. needs to use a steam injector (see Figure 3 of Matzie et al.) to force the suppression tank water into the reactor pressure vessel. Therefore, Matzie et al. does not teach or suggest the method of Claim 21. West et al. was cited to allegedly provide teaching as to the about three hour time period in Claim 21. As discussed above in connection with the Section 112 rejection, West et al. is directed to a conventional PWR where the steam generators are separate from the reactor pressure vessel and connected thereto by large primary coolant piping, which is subject to rupture creating different problems that are solved in a different way. There is nothing that would suggest combining the teachings of these two different systems of Matzie et al. and West et al. that would suggest the Claim 21 process. Therefore, Claim 21 is not obvious in view of Matzie et al. and West et al., whether taken singularly or in combination.

Claims 23 and 28 depend from Claim 21 and are therefore patentable over the references for the same reasons.

Rejection of Claims 24-27 and 29 Under 35 USC § 103(a)

Claims 24-27 and 29 were rejected under 35 USC § 103(a) as being unpatentable over Matzie et al. in view of West et al. It was asserted that Matzie et al. discloses the claimed invention except that the suppression tank does not flood a cavity beneath the reactor core. These claims all depend from Claim 21 and are therefore patentable over the references for the same reasons. In addition, Claim 21 calls for the suppression tank to be in the containment structure. This is contrary to the teachings of Matzie et al. where the suppression tanks are outside of containment so that the heat is passed to the atmosphere from the finned tanks, a different process of heat removal from that claimed. Furthermore, Claim 24 calls for using the gas in the at least one suppression tank to **passively** transfer at least some water in the suppression tank to the flood-up cavity. West et al. requires the operation of a valve 78 in order to transfer water to the sump 38. In the claimed process, gas compressed in the suppression tank is transferred out of the suppression tank into the flood-

up cavity through a sparger positioned below the surface of the water in the suppression tank without operation of any valves or other components, when the pressure of this compressed gas falls below the pressure in the containment structure. See specification page 8, lines 20-32. Accordingly, Claim 24, and Claim 26, which is similarly limited, further patentably distinguish over the references.

Claim 25 also further patentably distinguishes over the references by calling for introducing the gas/steam mixture from the containment structure into the suppression tank at a level selected to transfer a first portion of the water in the at least one suppression tank to the flood-up cavity leaving a remaining portion of the water in the at least one suppression tank for selective transfer to the reactor pressure vessel by gravity. Neither of the references, whether taken singly or in combination in any way suggest such a combination.

Rejection of Claims 30-31 Under 35 USC § 102(b)

Claims 30-31 were rejected under 35 USC § 102(b) as being anticipated by Matzie et al.

Claim 30 as now presented calls for, *inter alia*, introducing non-condensible gas and steam from the containment structure into the water in a suppression tank to condense the steam and compress the non-condensible gas, and then selectively transferring water from the suppression tank to the reactor pressure vessel by reducing pressure in the reactor pressure vessel by removing heat directly from the reactor pressure vessel to outside the containment structure thereby lowering the containment structure pressure and allowing the compressed non-condensible gas in the suppression tank to push the water from the suppression tank into the reactor pressure vessel. As discussed above, this removal of heat from the reactor pressure vessel is accomplished through the secondary circuit and results in condensation of steam in the reactor pressure vessel so that the gas compressed in the suppression tank has enough pressure to force water from the suppression tank into the reactor pressure vessel. As detailed above, Matzie et al. does not directly withdraw heat from the reactor pressure vessel so that the pressure remains high and it is necessary for Matzie et al. to use a steam injector in order to transfer water from the suppression tank into the reactor pressure vessel. Thus, Matzie et al. is directed to a different process which operates in a different way from the method set forth in Claim 30 and therefore the claim is not anticipated by the reference.

Claim 31 depends from Claim 30 and is therefore patentable over the reference for the same reasons.

Rejection of Claims 32-36 Under 35 USC § 103(a)

Claims 32-36 were rejected under 35 USC § 103(a) as being unpatentable over Matzie et al. in view of West et al.

Claim 32 is similar to Claim 30 except that it calls for transferring water from the suppression tank to a flood-up cavity instead of directly to the reactor pressure vessel. Again, this is accomplished by reducing pressure in the reactor pressure vessel by removing heat directly from the reactor pressure vessel to outside the containment structure through the secondary circuit. This reduces the pressure in the reactor pressure vessel and then through the break also reduces pressure in the containment structure so that the compressed non-condensible gas in the suppression tank can push water from the suppression tank to the reactor pressure vessel. No action in the way of human intervention or operation of any valves is required to effect this transfer. As discussed above, neither Matzie et al. nor West et al. teach or suggest removing heat directly from the reactor pressure vessel, and hence, even if their teachings are combined there is no suggestion of the combination of Claim 32 which is therefore patentable over the references.

Claims 34-36 all depend from Claim 32 and are therefore patentable over the references for the same reasons. Claim 36 further patentably distinguishes over the references for the same reasons discussed in connection with Claim 25.

In view of all of the above, reconsideration and allowance of the application as now presented is respectfully requested.

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